



## EXPLORE AND DISCOVER

### *A NASA Train Like An Astronaut Mission Handout – Instructor Guide*

#### **Learning Objectives**

Students will:

- safely carry weighted objects from the Exploration Area back to your Base Station to improve aerobic and anaerobic fitness; and
- record observations about improvements in aerobic and anaerobic fitness during this physical experience in their Mission Journal.

#### **Introduction**

Have you exercised your heart today? Most students exercise their heart and don't even know it. If students have played soccer, basketball, hopscotch, jumped rope, gone swimming, or rode their bike to school, they have exercised their heart. The heart is a muscle that works better when it is strong. The heart can become stronger with regular physical activity and exercise. It is important to get involved in physical activity in order to get, and keep, the heart and other muscles physically fit. Get your body moving and make your heart stronger.

Exercise is essential to maintaining cardiovascular health, bone strength, and strong muscles. The two types of exercise are aerobic and anaerobic and they work together to give you a healthy heart and body. Aerobic exercise involves the use of oxygen to produce energy, whereas anaerobic exercise makes the body produce energy without oxygen. You may be asking yourself which of these two types of exercise is most important for the body. Both types of exercise are important for optimum health.

The literal meaning of aerobic is oxygen. Aerobic exercise includes any activity that uses the large muscles of the body such as the arms and legs. When these muscles move in repetitive motion for an extended period of time oxygen is carried to the cells and energy is released. Ideally, the activity should last at least 20 minutes include constant movement. It helps reduce stress, increases blood circulation, strengthens the heart and lungs, and builds endurance. When you participate in aerobic activity for at least 20 minutes a day, you will find you also have more energy and feel healthier.

The literal meaning of anaerobic is in the absence of oxygen. Anaerobic exercise includes activities that build agility as well as strengthen and tone muscles. However, anaerobic activities are not as beneficial to the heart and lungs as aerobic activities. Anaerobic activity has been shown to increase your longevity. For example, resistance training increases bone mass, reduces muscle loss, and improves balance.

It is important to have a balanced exercise regiment and exercise routine that incorporates both aerobic and anaerobic activities. Both types of exercise will help maintain muscle, improve bone density, and optimize the cardiovascular system. This will provide benefits of optimal physical fitness.

Exercise is important to people on Earth, but it is crucial for astronauts who travel into space. Astronauts don't feel the effects of gravity; therefore, astronauts don't use their muscles as much during normal everyday activities in space as they do on Earth. For example, on Earth, every time you take a step, you lift the weight of your body using your muscles.

In space, astronauts experience microgravity, which makes them feel weightless. Moving within the capsule is an effortless task in a microgravity environment. Imagine floating around the room and moving objects around with one small push. Astronauts are not using their muscles to their full potential in the microgravity environment of space. Therefore they begin to lose strength because their muscles have become weak. They also experience a decrease in bone density, a loss of muscle mass, changes in heart and blood vessels as well as a shift in fluids.

To counteract these changes, astronauts must continue aerobic and anaerobic exercise in space. Keeping physically fit during their stay in space will also help them adapt to Earth's gravity upon their return. An astronaut does not want to return to Earth with limited use of his or her muscles; therefore, every astronaut follows a series of exercises based upon their individual fitness needs and goals. Both the space shuttle and International Space Station (ISS) are equipped with exercise equipment adapted to work in the microgravity environment of space. Astronauts follow an exercise schedule to do aerobic and anaerobic exercises to countermeasure the effects of microgravity on their bodies.

Next time you have to move large bulky objects around the house or in your classroom, imagine what it would be like to move that object if you had just spent six months in space without working on your aerobic and anaerobic fitness. Do you think that would be an easy task?

As students plan their fitness activities for the day, encourage them to include both aerobic and anaerobic activities in their plan. Here is a list of examples of aerobic and anaerobic activities.

Aerobic Activities	Anaerobic Activities
Brisk Walking Dancing Jogging Bicycling Skating Swimming Snow Shoveling Leaf Raking Lawn Mowing Jumping Rope	Baseball Sprinting Tennis Weightlifting Leg Lifts Arm Circles Sit-ups

## Administration

Follow the outlined procedure in the Explore and Discover Mission Handout. The duration of this activity can vary, but will average **30-45 minutes**.

Follow Set-up Procedures to prepare the Mission Samples and the Exploration Area.

- The day before students start their mission, instruct students how to take a proper heart rate (See Appendix A).
- Students should lie on the floor and relax for 1-3 minutes. Read the following passage while the students are at rest.
- Your heart is a muscle that pumps blood throughout your body. It is your body's engine. Your heart rate is a measurement of how many times it beats in a minute. The more your

heart beats, the more it is working. Target heart rates let you measure your initial fitness level and monitor your progress in a fitness program.

- At the end of 1-3 minutes, have students stand up and find their pulse. Once they have found their pulse, as a class they will take their heart rate. Students will take their pulse rate using the instructions found in Appendix A.
- Explain to the students how they will take their heart rate before and after Exploration Mission One and Exploration Mission Two. Since most groups will complete mission one and mission two at different times it is important for students to take their heart rate immediately after completing each mission.
- To stress the aerobic system, instruct students to continue to move around the entire time in one designated location including between Exploration Mission One and Exploration Mission Two. Do not allow time to rest until all the mission samples are found and both Exploration Mission One and Exploration Two are completed.
- Focus students on working together and practicing being safe while lifting and carrying. Emphasize safety to your students by going over proper lifting techniques with them prior to starting this activity. Go to the provided resources for proper lifting techniques.
- Divide students into teams of two. Students should keep the same roles in both Exploration Mission One and Exploration Mission Two. This is important to keep a constant variable and see results.
- There will be two students working at each Base Station. This makes 12 student's total exploring at one time. If your class is larger than 12 students have the remaining students sit on the sidelines as mission controllers.
- The mission controllers will be observing and making sure each team is following directions carefully. The mission controllers will write their observations about each exploration mission. These observations include:
  - Are the teams working well together?
  - Are they following all the instructions?
  - Are they walking, starting at the Base Station, and standing to squeeze the stress balls?
  - They will also make observations about the team's aerobic and anaerobic activity. What is the difference between the two in the activity?
  - Finally they will write about how they think the heart rate will change.
  - Do the heart rates of the explorers go up as they explore?
  - Why is the heart rate rising?
  - Have students perform Exploration Mission One.
  - Remind students to record their heart rate in their Mission Journal after Exploration Mission One. The mission control medic is responsible for collecting this data.
  - Have students perform Exploration Mission Two.
  - Once each team completes their missions, have them come back to their Mission Journal and write an observation about their own mission, answering similar questions as the mission controllers did about the mission's they observed.
  - If time permits in your schedule, allow students to change positions and start the activity again. This time the explorer becomes the mission control medic.

*Optional: To measure distance traveled, educators may wish to provide students with a wearable pedometer.*

## Location

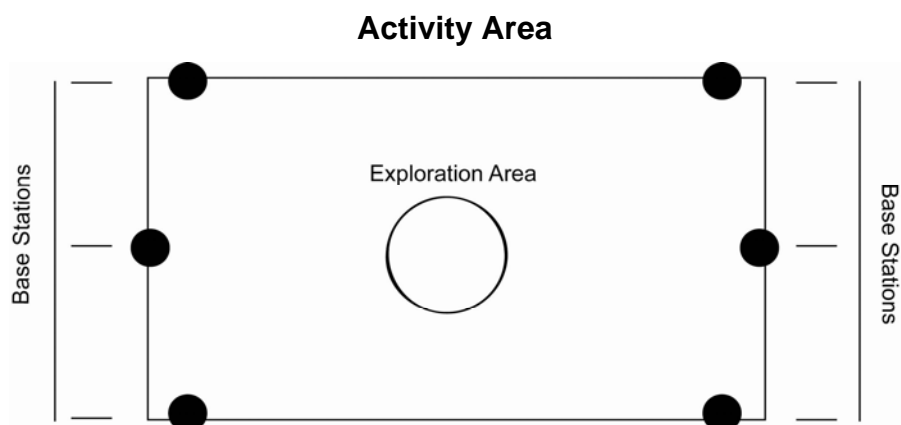
This activity may be conducted indoors in a large area such as a gym with a basketball court or an outdoor activity area.

## Set-up

Preparing the Mission Samples:

- Collect 30 balls (mission samples) in five different weights and sizes. These balls will represent mission samples collected by explorers.
- Use the tape and markers to label the balls as various space objects such as, rocks, meteorites, comets, asteroids, space debris, and satellites.

Preparing the Exploration Area:



- In the diagram above the black dots represents the base station for each team. The black lines represent the sidelines of the basketball court. This is the area behind the basketball net and the area on the sides of the exploration area. The hula hoops go in the center as the exploration area. Identify a large area free of obstacles to perform this activity.
- Place hula hoops flat on the floor to keep the mission samples from rolling out of the Exploration Area. In no particular order, place the mission samples in the Exploration Area. Teams may not go out of this area to find mission samples.
- Designate six Base Stations on the outside of the activity area evenly spread at an equal distance from the Exploration Area. These areas will be the Base Stations for the teams. Place a sign at each base station to designate their locations and identify groups.

## Equipment

- Mission Handout
- Mission Journal and pencil
- 12 stress balls (a small object or ball students can squeeze in their palm)
- 30 balls in five different weights and sizes, such as:
  - six tennis balls
  - six softballs
  - six soccer balls
  - six basketballs

- six large yoga balls or exercise balance balls
- three hula hoops, these will keep the balls from rolling away from the Exploration Area
- a watch, six stopwatches, or clock with a second hand to take heart rate
- markers to write space object names on balls
- masking tape to write space object names on balls

#### Optional equipment

- heart rate monitor
- pedometer

*If any of the data collection devices listed are new to the students, consider familiarizing the students with that instrument a few days before the physical activity begins.*

### Safety

- It is important that the students walk, not run, at all times during this activity.
- While objects may be located in or near the path of the students, every attempt should be made to keep the area safe for students to walk.
- The weight of all objects should not exceed 15 pounds (6.8Kg).
- Always stress proper technique while performing exercises. Improper technique can lead to injury.
- Proper hydration is important before, during, and after any physical activity.
- Be aware of the signs of overheating.
- A warm-up/stretching and cool-down period is always recommended.

*For information regarding warm-up/stretching and cool-down activities, reference the Get Fit and Be Active Handbook (ages 6-17) from the President's Council on Physical Fitness and Sports at <http://presidentschallenge.org/tools-resources/docs/getfit.pdf>.*

### Monitoring/Assessment

Ask the Mission Question found on the student mission handout before students begin the physical activity. Have students use descriptors to verbally communicate their answers.

Use the following open-ended questions **before, during, and after** practicing the physical activity to help students make observations about their own physical fitness level and their progress in this physical activity:

#### Questions to Ask Before

- How do you feel?

#### Questions to Ask During

- When did you feel your heart beat fastest?
- When did you feel yourself breathing hardest?
- What muscles did you use to lift the mission samples?
  - upper and lower back muscles
  - arm muscles
  - leg muscles
  - abdominal muscles
- What made this activity aerobic?

- What made this activity anaerobic?
- What other activities might be aerobic or anaerobic?
- What challenges did you face exploring for the mission samples?
- What are some challenges astronauts may face in exploring for objects?
  - the microgravity environment of space
  - no atmosphere
  - wearing a bulky space suit with limited movement
  - limited time for exploration
  - not having the right tools for exploration

#### Questions to Ask After

- What challenges did you face in getting the mission samples to the Base Station?
- What are some challenges astronauts may face in safely returning objects or samples?
  - not having the proper equipment for exploration
  - objects may be too bulky to carry
  - objects may be contaminated with other material
- Did it get harder as you found more mission samples?
- How well did you work with your team?
- Would it be easier working alone? Why?
- Would it be easier for astronauts to explore without their crew members? Why?
- Would these objects weigh the same on the Moon or Mars?
- The mass, amount of material that makes up an object, will always be the same.
  - The weight of an object, which is due to gravity, will change. Each planet has a different gravitational pull. The greater the gravitational pull, the more an object will weigh. The weaker the gravitational pull, the less an object will weigh. Let us examine the Moon and Mars.
    - The force of gravity at the surface of an object is the product of the object's mass and size; therefore the surface gravity of the Moon is only one-sixth that of Earth. The Moon's mass is about (1/80) one-eightieth of the Earth's mass. As mentioned before, the force gravity exerts on a person determines the person's weight. Recall that although your mass is the same on Earth and the Moon your weight would be different. For instance, if you weigh 132 pounds (60 kilograms) on Earth, you would weigh about 22 pounds (10 kilograms) on the Moon.
    - The gravity on Mars is much lower than on Earth, In fact the gravity on Mars is 38% the gravity on Earth. If you weigh 220 pounds (100 kilograms) on Earth, you would only weigh 84 pound (38 kilograms) on Mars.

Some quantitative data for this physical activity may include:

- number of mission samples found
- length of time for all mission samples to be found
- size of the area explored
- monitoring heart rate (beats per minute)
- steps taken (using a pedometer)
- rate of perceived exertion (Use a scale of 1-10 to analyze how students perceived their exertion from the qualitative data)

Some qualitative data for this physical activity may include:

- identifying challenges in communication
- identifying perceived exertion (How hard you feel your body is working?)

### **Collect, Record, and Analyze Data**

Students should record observations about their physical experience in their Mission Journal before and after the activity. They should also record their physical activity goals and enter qualitative data for drawing conclusions.

- Monitor student progress throughout the physical activity by asking open-ended questions.
- Time should be allotted for the students to record observations about their experience in their Mission Journal before and after the physical activity.
- Graph the data collected in the Mission Journal on the graph paper provided, letting students analyze the data individually. Share graphs with the group.

*Students should practice the Mission Handout physical activity several times before progressing or trying the related Fitness Acceleration and Mission Explorations.*

### **Fitness Acceleration**

- In a large defined area search for five hidden mission samples. Try to find and return five objects to your Base Station in two minutes. Make sure to check your heart rate before and after the exploration.

*The teacher will hide various items in a large defined area. These items can be from around the classroom that students can lift such as a stapler, tape dispenser, etc. Time the students.*

- Each group should try to find a specified amount of mission samples in a given amount of time. These mission samples must have a combined weight of at least 15 lbs (6.8Kg). For example, you have five minutes to find four mission samples that have a combined weight of 15 lbs (6.8Kg).

*Have a scale available to students to find the weight of their mission samples. Use various objects other than balls such as clip boards, staplers, or different objects in the classroom.*

### **Mission Explorations**

- Create a class graph that includes the heart rates of each explorer at the beginning of their mission and the end of their mission. Compare your data with the class. How did the heart rate change throughout this Train Like an Astronaut mission?
- Create a list of clues for finding a hidden object of your choice. Give these clues to other class members and have them explore for that hidden object.

### **National Standards**

National Physical Education Standards:

- Standard 1: Demonstrates competency in motor skills and movement patterns needed to perform a variety of physical activities.
- Standard 2: Demonstrates understanding of movement concepts, principles, strategies, and tactics as they apply to the learning and performance of physical activities.
- Standard 3: Participates regularly in physical activity.

National Health Education Standards (NHES) Second Edition (2006):

- Standard 4: Students will demonstrate the ability to use interpersonal communication skills to enhance health and avoid or reduce health risks.
  - 4.5.1. Demonstrate effective verbal and non-verbal communication skills to enhance health.
- Standard 6: Students will demonstrate the ability to use goal-setting skills to enhance health.
  - 6.5.1 Set a personal health goal and track progress toward its achievement.

National Science Education Standards:

- Standard F: Science in Personal and Social Perspectives
  - Personal health (K-8)
- Standard B: As a result of the activities in grades K-4, all students should develop an understanding of:
  - properties of objects and materials
  - position and motion of objects

## National Initiative

Supports the *Local Wellness Policy*, Section 204 of the Child Nutrition and WIC Reauthorization Act of 2004 and may be a valuable resource for your Student Health Advisory Council in implementing nutrition education and physical activity.

## Resources

For more information about space exploration, visit [www.nasa.gov](http://www.nasa.gov).

Access fitness-related information and resources at [www.fitness.gov](http://www.fitness.gov).

View programs on health and fitness:

Scifiles™ The Case of the Physical Fitness Challenge  
<http://www.knowitall.org/nasa/scifiles/index.html>.

NASA Connect™ Good Stress: Building Better Bones and Muscles  
<http://www.knowitall.org/nasa/connect/index.html>.

For information on proper lifting technique:

[http://www.mayoclinic.com/health/back-pain/LB00004\\_D](http://www.mayoclinic.com/health/back-pain/LB00004_D)

For more information on aerobic and anaerobic systems:

<http://www.americanheart.org/presenter.jhtml?identifier=3003065>

For guidelines to prevent heat-related illnesses:

National Athletic Trainers' Association (NATA)

- Exertional Heat Illness (Position Statement)  
<http://www.nata.org/statements/position/exertionalheatillness.pdf>
- How to Recognize, Prevent & Treat Exertional Heat Illnesses  
<http://www.nata.org/newsrelease/archives/000056.htm>

Centers for Disease Control and Prevention (CDC)

- Extreme Heat: A Prevention Guide to Promote Your Personal Health and Safety  
[http://www.bt.cdc.gov/disasters/extremeheat/heat\\_guide.asp](http://www.bt.cdc.gov/disasters/extremeheat/heat_guide.asp)

For guidelines for fluid replacement and exercise:

National Athletic Trainer's Association (NATA)

- Fluid Replacement for Athletes (Position Statement)  
<http://www.nata.org/statements/position/fluidreplacement.pdf>

For information on warm-up and cool-down stretches, visit:

American Heart Association (AHA)

- Warm-up and Cool-down Stretches  
<http://americanheart.org/presenter.jhtml?identifier=3039236>

For information about rate of perceived exertion (RPE), visit:

Centers for Disease Control and Prevention (CDC)

- Perceived Exertion  
[http://www.cdc.gov/nccdphp/dnpa/physical/measuring/perceived\\_exertion.htm](http://www.cdc.gov/nccdphp/dnpa/physical/measuring/perceived_exertion.htm)

For guidelines on heart rate and exercise, visit:

Centers for Disease Control and Prevention (CDC)

- Target Heart Rate and Estimated Maximum Heart Rate  
[http://www.cdc.gov/nccdphp/dnpa/physical/measuring/target\\_heart\\_rate.htm](http://www.cdc.gov/nccdphp/dnpa/physical/measuring/target_heart_rate.htm)

American Heart Association (AHA)

- Target Heart Rates  
<http://www.americanheart.org/presenter.jhtml?identifier=4736>

## Credits and Career Links

*Lesson development by the NASA Johnson Space Center Human Research Program Education and Outreach team with thanks to the subject matter experts who contributed their time and knowledge to this NASA Fit Explorer project.*

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Astronaut Strength, Conditioning & Rehabilitation (ASCR) Specialists

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<http://www.wylelabs.com/services/medicaloperations/ascr.html>

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<http://www.nasa.gov/centers/johnson/slsd/about/divisions/hacd/project/exercise-countermeasures.html>

## Finding Your Heart Rate

### Pulse

What is your pulse? Your pulse is your heart rate, or the number of times your heart beats in one minute. Your pulse rates may be different than your classmates. Your pulse is lower when you are at rest and increases when you exercise. Your pulse goes up because more oxygen-rich blood is needed by the body when you exercise.

### Finding your pulse on your wrist:

1. Place the tips of your index, second, and third fingers on the palm side of your other wrist, below the base of the thumb.
2. Move your fingers to just about an inch below the thumb base and press down lightly until you feel an intermittent "throbbing" sensation in your wrist; that's your pulse.
3. Use a stopwatch, watch with a second hand, or look at a clock with a second hand.
4. Count the beats you feel for 10 seconds. Multiply this number by six to get your heart rate (pulse) per minute.

### Finding your pulse on your neck:

1. Place the tips of your index and second fingers on your lower neck, on either side of your windpipe or Adams apple.
2. Press down lightly until you feel an intermittent "throbbing" sensation in your wrist; that's your pulse.
3. Use a stopwatch, watch with a second hand, or look at a clock with a second hand.
4. Count the beats you feel for 10 seconds. Multiply this number by six to get your heart rate (pulse) per minute.

### Finding your resting heart rate and target heart rate:

Find your Target Heart Rate (THR) and enter it in your Mission Journal.

$$(220 - \text{your age}) 0.7 = \text{THR}$$

### Mission One:

1. Resting Heart Rate: \_\_\_\_\_ X 6 = \_\_\_\_\_  
(Beats in 10 seconds) (Your Pulse)

2. Heart Rate after completing Mission One: \_\_\_\_\_ X 6 = \_\_\_\_\_  
(Beats in 10 seconds) (Your Pulse)

Did your heart rate increase? ☐ YES ☐ NO

If yes, how much did your heart rate increase? \_\_\_\_\_

### Mission Two:

1. Heart Rate after completing Mission One: \_\_\_\_\_ X 6 = \_\_\_\_\_  
(Beats in 10 seconds) (Your Pulse)

2. Heart Rate after completing Mission Two: \_\_\_\_\_ X 6 = \_\_\_\_\_  
(Beats in 10 seconds) (Your Pulse)

Did your heart rate increase? ☐ YES ☐ NO

If yes, how much did your heart rate increase? \_\_\_\_\_

What is a normal pulse?	
Age Group?	Normal Heart Rate at Rest
Children (Ages 6-15)	70-100 beats per minute